Speech Studio Service Manual

Laryngograph ®

1 Foundry Mews, London, NW1 2PE
Tel: +44 (0)207 387 7793 Fax: +44 (0)207 383 2039

lx@laryngograph.com www.laryngograph.com

CE

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Basic system requirements for Speech Studio

1. A **Laryngograph Processor** which provides the Laryngograph (Lx) and Speech (Sp) pressure waveform, and period marking pulses (Tx).
2. A **PCLX card** which converts the analogue waveforms into digital form (up to 4 channels), measures the Tx pulse to 1uSec resolution, and runs several real time speech analysis algorithms.
3. A **PC**: minimum Pentium II 500MHz with a full length ISA slot, graphics card with 64MB RAM, 128MB RAM, 30GB HDD and running Windows 98E.
4. The **Speech Studio software**. This currently contains two programs
    - SPEAD (Speech Pattern Element Display and Acquisition): A real time speech display system.
    - Qa (Quantitative analysis): an off line program for providing extensive analysis of the structure of continuous speech

Speech Studio can be enhanced by the addition of further hardware and software modules for nasality and airflow.

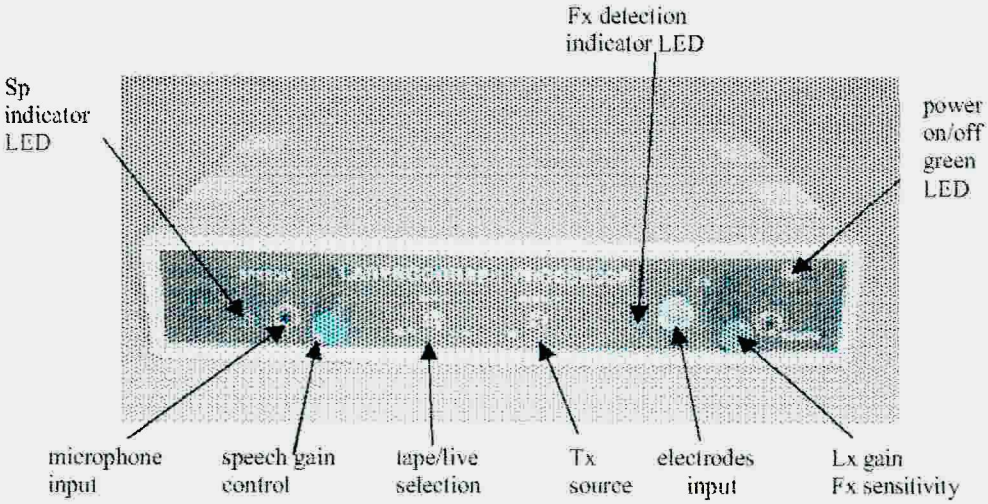
The Lx **Nasality Processor** supplies a signal from an accelerometer which is stuck on the nose as a simple measure of nasal wall vibration.

Laryngograph Processor

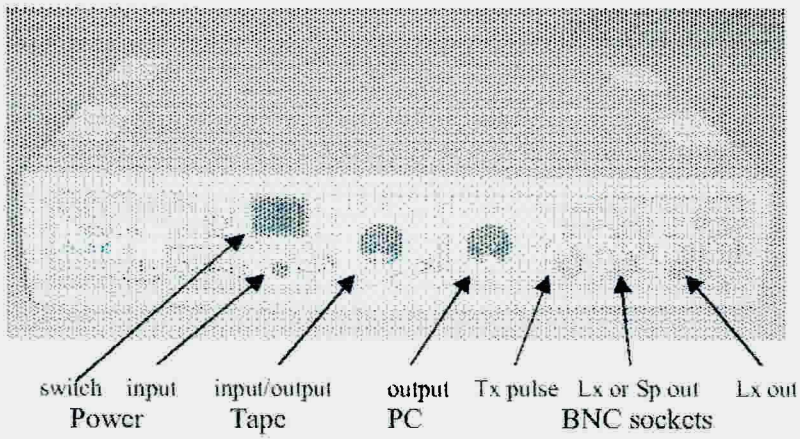
The Laryngograph Processor is an all-in-one electro-laryngograph, microphone pre-amplifier, and speech or laryngograph based fundamental frequency ("pitch") extractor. It is powered by a mains connected power supply with the option of an internal 12v lead acid battery for portable use.

It links simply to a recorder (e.g. cassette or DAT) for the recording or playback of the Speech (Sp) and Laryngograph (Lx) waveforms and to the PCLX Interface card which can be fitted to a compatible PC for the display, analysis and printout of the speech and Laryngograph waveform and corresponding fundamental frequency.

It is supplied with a small high quality electret microphone to pick up the speech pressure waveform (Sp) and a set of electrodes which, when positioned on the neck either side of the thyroid cartilage, detect the small, relatively rapid, variations in the conductance between the electrodes, produced by changes in the nature and area of vocal fold contact during voiced speech.



Front Panel



Rear Panel

Power

The Laryngograph Processor is powered by its own mains connected power supply. The green power LED lights up when the unit is switched on when the power supply is connected and, if an internal battery is fitted, when the external supply is disconnected. With no supply the LED changes colour to yellow when the battery requires charging and, if the battery is completely discharged then the LED is not illuminated. If the optional battery is fitted, when the power supply unit is connected the Processor will be driven from this source and the battery will be simultaneously charging. A fully charged battery will give approximately thirty hours continuous use before the power LED changes from green to amber. Once this change occurs there will be approximately 5 hours life remaining, but you are advised to recharge as soon as is possible. Allow 20 hours for complete battery recharge with the Lx Processor

switched off. If the Laryngograph Processor is not to be used for more than two months, any battery must be removed. After use, please take care to switch off at the back panel of the Laryngograph Processor.

The Laryngograph Processor has two internal 500mA(T) fuses.

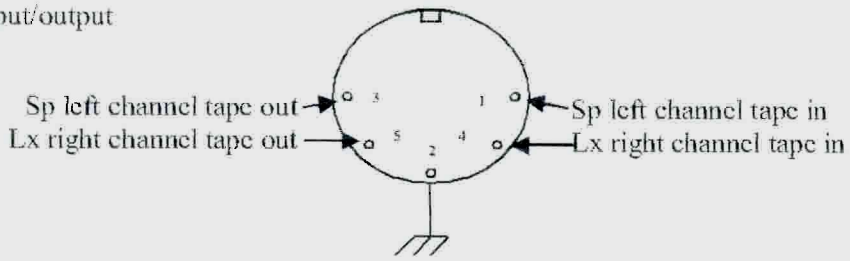
Outputs

The speech (Sp) and Laryngograph (Lx) waveforms are accessible as ± 5V, 600 Ohm signals from several points on the back of the unit:

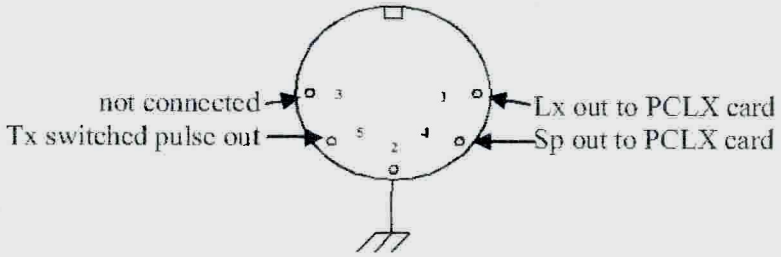
- One socket allows a single lead to be used for both the recording and playback of Sp and Lx waveforms
- An "Aux Output" socket is used for a direct link to the PCLX card in a PC
- BNC sockets allow the speech, Lx and Tx (period marking pulses) signals to be separately monitored.

Output connections viewed from outside

Tape input/output



AUX out



BNC connectors

Lx Out:	Lx signal at fixed gain.
Pulse:	Tx (period marking) pulses. If the Output switch on the front panel is in the Lx position (default) these are derived from the Lx waveform. In the Sp position they are derived from the speech waveform.

Waveform: Lx or speech waveform depending on the position of the Output switch on the front panel. Amplitude is controlled by the respective gain control.

Linking to a PC

To use the Processor with the Speech Studio program you must have a PCLX card installed in the PC and a suitable lead to connect them (available from Laryngograph). A computer supplied by Laryngograph Ltd has the PCLX card installed and configured.

Install a PCLX card:

1. Check PCLX card settings and write them down:

I/O address is defaulted as **2C0**. The "**Address bits**" DIP switch state should be: **ON(1,2,3,4,7); OFF(5,6,8).** Please do not change to other values.

Check and make sure **IRQ** jumper is on 5. **Never use IRQ 7, 15.**

DMA is defaulted as 3. There is no need to change it.

The PCLX card settings are:

I/O Address: **IRQ:** **DMA:**

2. Install the PCLX card into a spare ISA (black) slot on the motherboard.

Switch off the PC first. Always screw down the mounting bracket to secure the PCLX card.

3. In the BIOS, set IRQ 5 for legacy ISA/EISA card.

4. Reserve resources for the PCLX card on your PC:

- Run System applet from Start/Settings/Control Panel.
- Click on the "Device Manager" tab, double click on the top item "Computer" to bring up the "Computer Properties" window. Click on the "Reserve Resources" tab.
- Add **IRQ** of the PCLX card first, then add Input/Output (I/O). Start value is 2C0. End value is 2CF.
- Restart the PC to allow the settings to become effective.

5. Install Speech Studio by running setup.exe from the installation CD

6. Start Speech Studio by double clicking the Spead icon. Run Help\PCLX Card to set the IRQ and I/O address. Make sure the IRQ is the one used by PCLX card, and I/O is 2C0. Under A/D channels check the 2 channel or 4 channel button depending on your card – contact Laryngograph if unsure.

7. Close the program and restart it again. The settings for the PCLX card are then completed.

Connect the Lx Processor AUX output socket to the D socket on the PCLX card at the back of the computer with the lead provided. Connect the speakers to the mini jack socket on the PCLX card.

Switch on the computer and the Lx Processor.

Plug in and position the microphone and electrodes.

Start Speech Studio.

Technical Specification

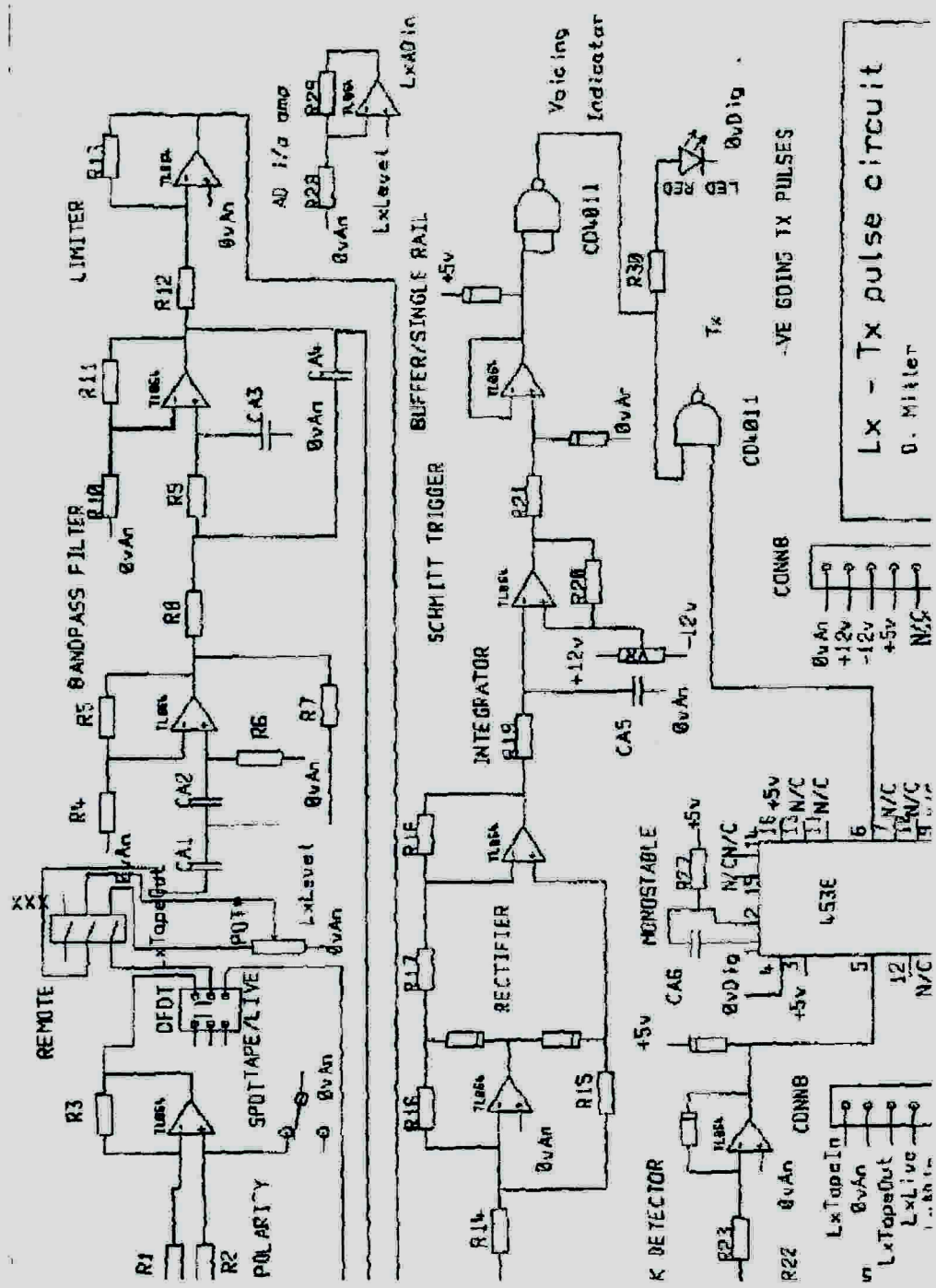
Output voltage range	6V pp maximum down to 20 mV pp noise
Output impedance	600 Ohms
Bandwidth	+/- 0.5 dB between 10 Hz & 5 kHz
Signal to noise ratio	Depending on the speaker, about 40 dB
Power source	Laryngograph Processor mains power supply or optionally a rechargeable lead acid 12V battery
Usage time with one charge	24 hours of continuous use
Battery check indicator	Shown by the colour change from green to yellow
Output level indicator	Green LED lights adjacent to the Sp and Lx input controls
Output level control	Via linear controls as immediately above
Size	5.5x27.5x29.5 cm (HxWxD) without handle
Weight	1.5 kg (with battery)
Safety	Complies with EN 60601-1 Class II Type BF

Please note that Laryngograph equipment is not designed either to be stored or to operate in abnormal conditions of either temperature or humidity. The room temperature should be within the range 15°C to 25°C and the relative humidity should be less than 75%. If the Laryngograph is not to be used for more than two months, the battery must be removed.

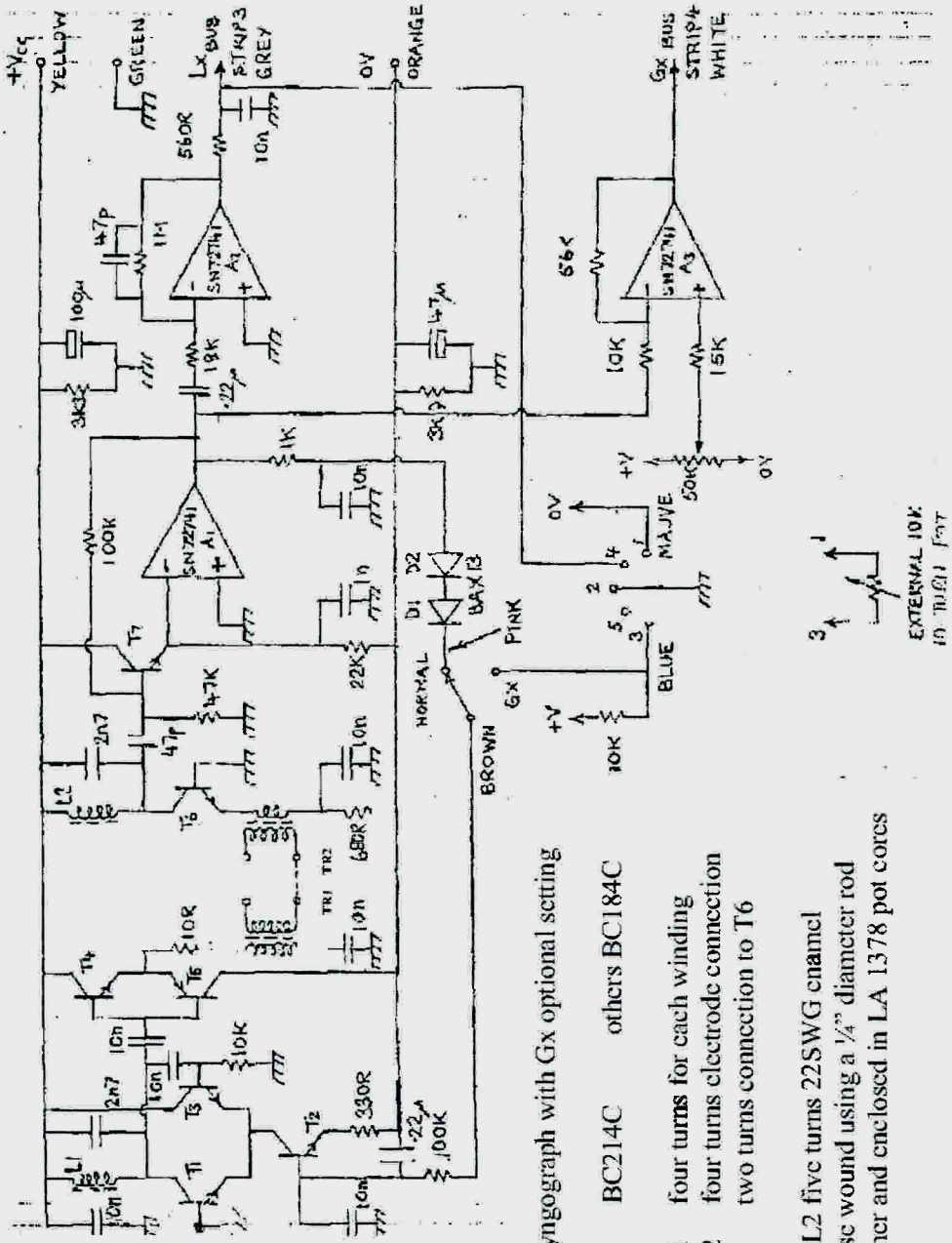
The exclamation mark symbol shown on the left is designed to draw the attention of the reader to the need to consult this Instruction Manual.

The symbol on the left refers to the "Type BF applied part" compliance of this equipment with the requirements for safety of medical electrical equipment as defined in EN 60601-1. (B *stands for body and* F *for floating.)*

Processor circuit diagrams



Laryngograph Processor
Tx pulse generator



Laryngograph with Gx optional setting

T5 BC214C others BC184C

TR1 four turns for each winding
TR2 four turns electrode connection
two turns connection to T6

L1, L2 five turns 22SWG enamel
close wound using a ¼" diameter rod
former and enclosed in LA 1378 pot cores

Basic Laryngograph module

The Laryngograph Processor version of this circuit does not include provision for the manual adjustment of the feedback bias control that is necessary to produce a true Gx signal. The low frequency cut-off does, however, permit swallowing obsevation.

PCLX interface card

There are no user serviceable parts on the PCLX card. Faulty cards should be returned to Laryngograph. The following is provided for information only.

The PCLX acquisition card provides multi-channel analogue waveform input at sampling rates of up to 50 kHz at 16 bits per channel with the possibility of simultaneous measurement of the period of the pulse train at the equivalent of 500 kHz sampling rate, for IBM PC compatibles. Playback of two channel analogue and measured period is possible. A signal processor and on board memory of up to 32 k words (64KBytes) makes real time processing possible. Provision has been made for communications with external devices e.g. for the control of gain settings. A full length expansion socket is required.

Standard provision

* Four channel analogue waveform acquisition at sampling rates of subdivisions of 32, 40, 44.1 and 48 kHz. A/D conversion is achieved by 1 bit, 64 x oversampling A/D convertors. Linear phase, anti-aliasing is achieved digitally. Data is transferred to the PC memory using DMA. On board buffering is sufficient to handle delays incurred when memory blocks have to be switched. A mini jack socket is provided for two channel analogue playback.
* Single channel period measurement on an external pulse train can be measured to 1μsec accuracy, simultaneously with waveform acquisition and independent of the analogue acquisition rate. The period measurement data can be played back through the loudspeaker on the PC. Where the period is the fundamental period of voiced excitation (Tx) the resulting output is a replay of voice fundamental frequency, the acoustic correlate of pitch.
* The TMS320C25-50 controls most of the acquisition process, it can communicate with the PC directly, and can run real time programs.
* 32K words (64KBytes) memory is provided as standard. This memory can be used for buffering; for TMS320 program storage, and by the PC.
* Sampling rates of 5, 10, 20, and 40 kHz.
* A synchronous serial port is provided which could be used for control of the input gain and other control circuits.
* There is 1 free digital input and one free digital output on the card.

Technical details

Size: 200 x 100 plus edge connector (needs full length PC ISA expansion socket).
Weight: 200gm.
Power consumption: (Typical) +5v 700mA; +12v 120mA; -12v 70mA.
Analogue inputs: input voltage maximum +/- 5v; input impedance 13.6 kOhms; Signal to noise ratio 90dB (typical). A-D convertors Crystal CS5336. Complete CMOS Stereo,16 Bit Delta-Sigma A/D converters, digital anti-aliasing filtering, S/H circuitry and Voltage reference.
Digital inputs and outputs: TTL compatible. Will drive one LS load.Period measurement on negative edge.

Analogue outputs: Stereo 16 bit D/A, signal to noise ratio 70dB. 4 pole Butterworth reconstruction filter which automatically tracks the sampling frequency (can be bypassed). Output voltage +/-2v.Output impedance 100 Ohms (sufficient to drive most headphones).

Routine Maintenance

The gold plated surfaces of the electrodes should be wiped with a clean damp cloth before each new application to the neck of a speaker. The additional routine use of, for example, cliniwipes or surgical spirit followed by drying with cotton wool is effective.

The green plastic backing on each electrode and the good condition of the Hypertac connector, on the electrodes lead, should be verified at least once a week – as a function of use.

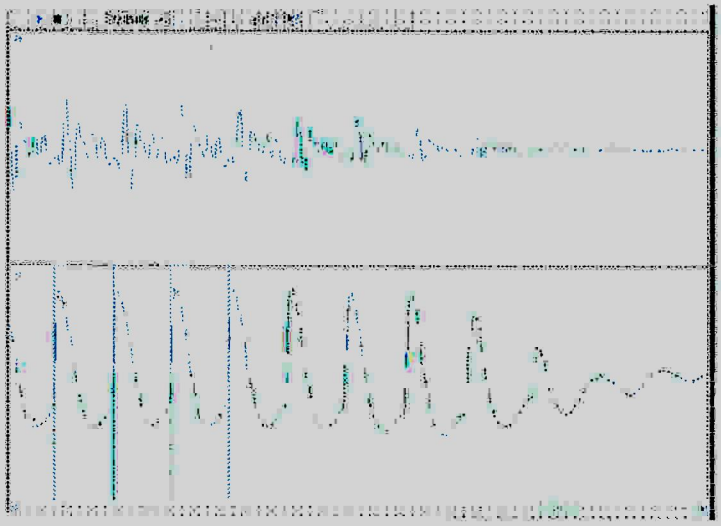
Electrodes and neckbands have limited life and are consumable items and must be replaced as a function of use.

The Processor case should be cleaned using a warm, damp cloth with the unit switched off. Do not use bleach or alcohol wipes.

If a battery is fitted it should be recharged as soon as possible after use.

The calibration of the Tx pulse circuit should be checked annually. Do this as follows:

- Set up the Processor for use and place the electrodes on your neck ensuring that the Sp and Lx LEDs light during voicing.
- Open Speech Studio, start a new document and enable the Waveform and Pattern displays. From the menu go to View/Waveform Control Bar and ensure that the Lx gain control is set to minimum.
- Start a continuous recording and phonate a sustained vowel at normal volume ensuring that there is a good Lx trace in the waveform display and pitch contour in the pattern display.
- Slowly reduce voicing volume until the pitch contour disappears.
- Stop the recording, right click the mouse in the waveform window and select toggle markers.
- Redraw the window by moving the position bar and blue period markers should appear on the Lx waveform – you may need to Zoom In.
- Check that the markers are positioned at the start of closure, that each cycle is marked during regular voicing and that as the amplitude of the Lx waveform drops as voicing diminishes, the markers stop. An example is shown below.



If there is any irregularity or misplacement of the markers recalibration may be required and you should contact the Laryngograph office.

A physical check of each of the components of the Speech Studio system and a safety test to IEC601 should be carried out annually.

Troubleshooting

If the unit fails to switch on check the power supply output and the internal 500mA fuses.

If there is no speech or Lx signal in Speech Studio go to the Set menu and check in Record Settings that the channels are set to Sp+Lx. From the View menu enable the Oscilloscope Bar and ensure that both Sp and Lx are selected. Check that the gain controls on the front panel are set appropriately.

If the respective LED on the front panel lights during voicing, check the output on the Waveform BNC connector with an oscilloscope (switch between Sp and Lx using the Output switch on the front panel, amplitude is controlled by the gain controls). If the signal is present check the connection from the PCB to the AUX out socket. If this is OK check the lead to the PC. If this is OK the PCLX card may be faulty. If the signal is not present the Processor PCB is faulty.

If the Sp and/or Lx LED doesn't light during voicing substitute a good microphone or pair of electrodes. If it still doesn't light the Processor is faulty.

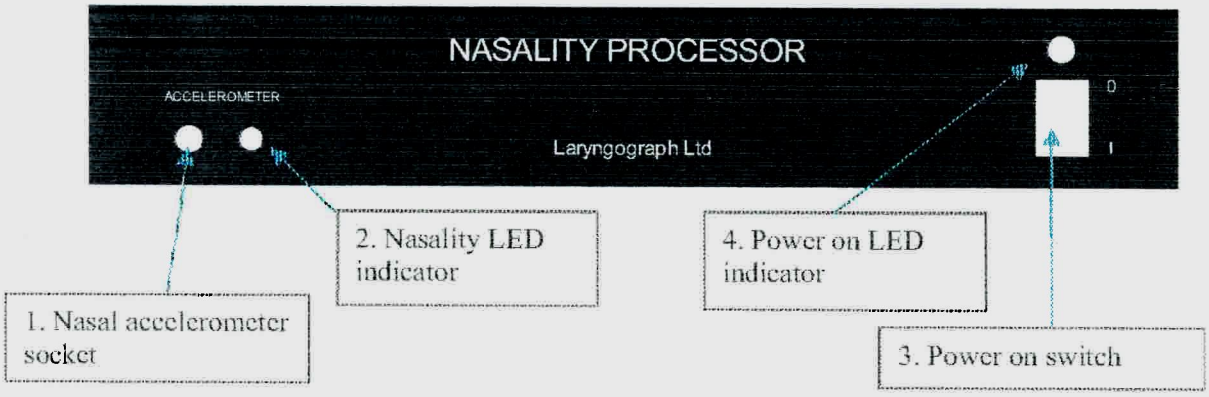
If the Lx signal is present in the waveform display but there is no Fx trace in the Pattern window follow the procedure for checking the Tx pulse circuit in Routine Maintenance.

For any Processor or PCLX card faults the respective unit should be returned to Laryngograph. Please telephone the Laryngograph office to arrange return.

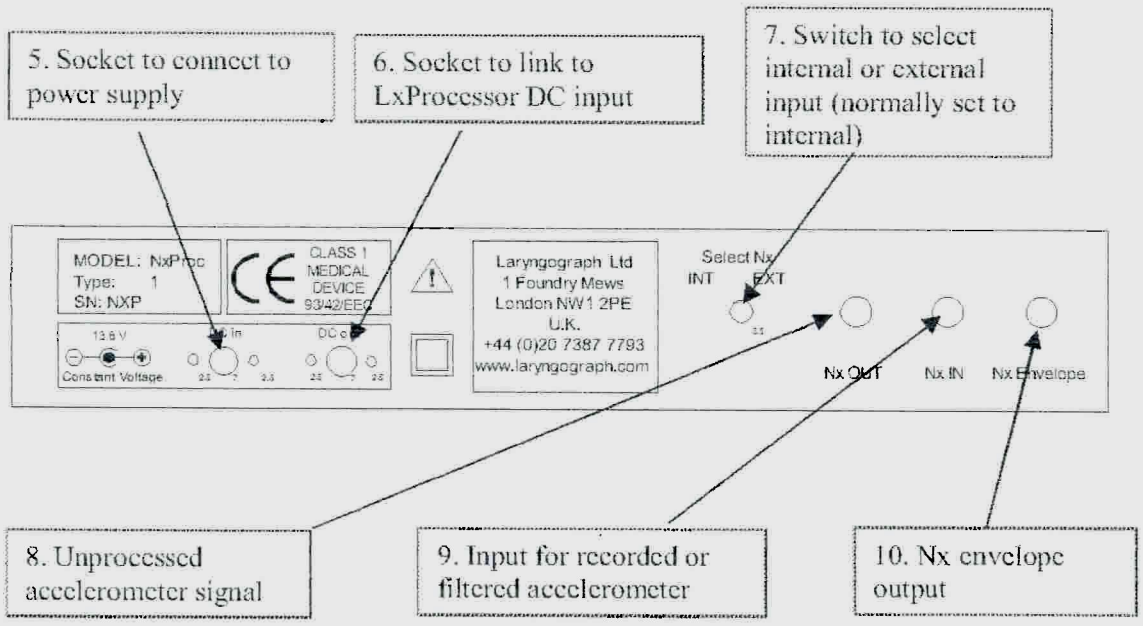
The Nasality Processor

The Nasality Processor is an optional module with Lx Speech Studio. The Nasality Processor is the same size as the Laryngograph Processor and the two units can be stacked one on top of the other. To view the Nasality signal, a 4 channel PCLX card is required and Speech Studio should be configured for 3 channels i.e. Speech, Lx and Nasality (Nx) (see User Guide – The Use of Set – Record Settings).

Front view

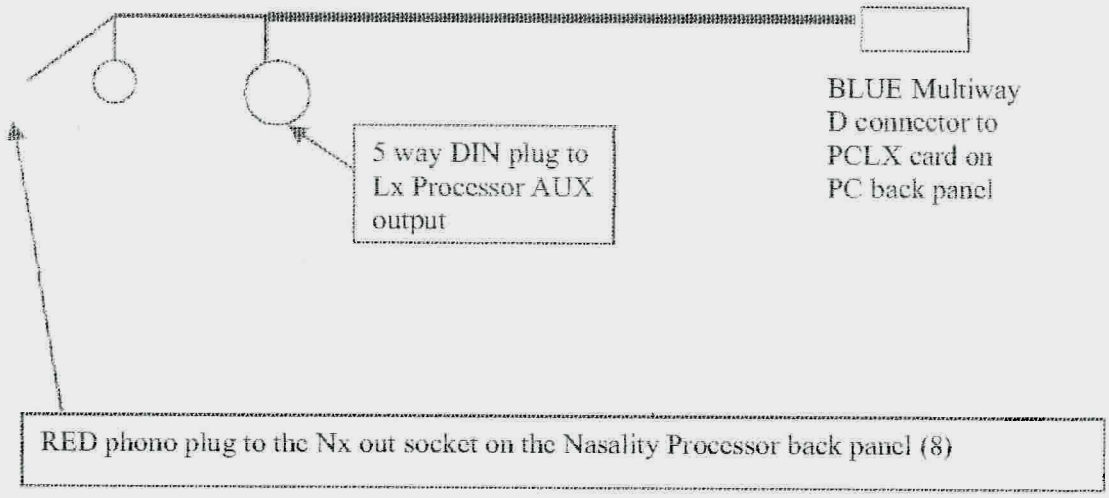


Back view



Signal connections

The Nasality Processor is connected into the Speech Studio system as follows:


BLUE Multiway D connector to PCLX card on PC back panel
5 way DIN plug to Lx Processor AUX output
RED phono plug to the Nx out socket on the Nasality Processor back panel (8)

Power

The Nasality Processor is powered by the Laryngograph Processor power supply and has the option of an internal 12v lead acid battery. Power can be supplied to each unit individually by connecting the Laryngograph Processor power supply directly to the DC input socket on either unit. Alternatively both units can be charged and powered in combination by connecting the power supply directly to the DC input of the Nasality Processor and then using the small connector supplied with the Nasality Processor to connect between the DC out of the Nasality processor and the DC in on the Laryngograph Processor.

When the unit is turned on (3) then the green LED (4) should be illuminated.

There is one 500mA(T) fuse on the PCB.

The accelerometer

The accelerometer is plugged into the socket (1).

The accelerometer is attached to the nose by means of double sided tape or with micropore tape. The accelerometer should be attached on the side of the nose by the most patent nostril (ask the subject to alternatively block each nostril and indicate which one it is easiest to breath through). The best position is on the flesh in the triangle between the bone and the nasal cartilage.

Routine Maintenance

Cleaning should be carried out using a warm, wet cloth with the unit switched off. Do not use bleach or alcohol wipes.

If a battery is fitted it should be recharged as soon as possible after use.

No periodic calibration is required.

A physical check and safety test to IEC601 (class II BF) should be carried out annually.

Troubleshooting

If the unit fails to switch on check the power supply output and the internal 500mA fuse.

If there is no nasality trace in Speech Studio go to the Set menu and ensure that in Record Settings the channels are set to Sp+Lx+Nx. If the nasality trace appears but there is no signal go to Help/PCLX card and check that A/D channels is set to 4. If there is still no signal and the LED (2) on the front panel lights when there is nasal wall vibration, check the output on the back panel (8) with an oscilloscope. If the signal is not present check the connections from the PCB to the phono socket. If the signal is present, check that the RED phono plug is connected to Nx OUT and check the lead from the phono plug to the PCLX card connector.

If there is no nasality signal in Speech Studio and the LED (2) on the front panel fails to light when there is nasal wall vibration, check the accelerometer mini jack connector. Substitute the accelerometer with a known good one if available.

If the Nasality Processor PCB is suspected to be faulty the unit should be returned to Laryngograph. Please telephone the Laryngograph office to arrange return.

DECLARATION OF CONFORMITY

Laryngograph Ltd.

1 Foundry Mews
London NW1 2PE

European Communities Council Directive 93/42/EEC
Concerning Medical Devices

Certificate No: DC-4

Issue A; October 2001

The undersigned declares that the products named in this certificate meet the provisions of this Council Directive and the CE Mark may be affixed.

General Product Names: Laryngograph Processor and Software; 3 variations;

1. Laryngograph Processor (PCLX) with PCLX DSP card, microphone and electrodes.
2. Basic PCLX system with Lx Processor, PC with PCLX card and Speech Studio software.
3. As item 2 but with the addition of a Nasality Processor

Manufacturer Laryngograph Ltd.
1 Foundry Mews
London NW1 2PE

Intended Use: Computer controlled diagnostic devices for the creation and recording of printable high quality images constructed during the analysis of speech and Laryngograph waveforms.

Notified Body British Standards Institution Medical Device Product Certification Maylands Avenue, Hemel Hempstead, HP2 4SQ UK.
Notified Body No. 0086

Sterile: No

Measuring Function: Yes.

Conforming to harmonised standards

EN 60601-1 Medical Electrical Equipment; general requirements for safety.
EN 60601-1-2 Medical Electrical Equipment Part 1; General requirements for safety - 2; Collateral standard; Electromagnetic compatibility - requirements and tests.

Directive Classification No: II(a)

Signed: ..... **Date** .....

Name: Mr Adrian Fourcin

Who are the natural and legal individuals with responsibility for the design, manufacture, packaging and labelling before the device is placed on the market under his own name, regardless of whether these operations are carried out by the Manufacturer or on his behalf by a third party.

Laryngograph ®

1 Foundry Mews, London, NW1 2PE
Tel: +44 (0)207 387 7793 Fax: +44 (0)207 383 2039

lx@laryngograph.com www.laryngograph.com

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